EX PARTE OR LATE FILED

ORIGINAL

wrf

Wiley Rein & Fielding LLP

RECEIVED

JUL 31 2001

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

1776 K STREET NW
WASHINGTON, DC 20006
PHONE 202.719.7000
FAX 202.719.7049

Virginia Office
7925 JONES BRANCH DRIVE
SUITE 6200
McLEAN, VA 22102
PHONE 703.905.2800
FAX 703.905.2820

www.wrf.com

July 31, 2001

Jennifer D. Hindin
202.719.4975
jhindin@wrf.com

Ms. Magalie Roman Salas, Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
12th Street Lobby, TW-A325
Washington, DC 20554

Re: **Written *Ex Parte* Presentation in 1998 Biennial Regulatory Review -- Amendment of Part 18 of the Commission's Rules to Update Regulations for RF Lighting Devices; ET Docket No. 98-42**

Dear Ms. Salas:

On July 26, 2001, at the request of Commission staff, Robert Briskman of Sirius Satellite Radio Inc. ("Sirius") provided the attached documents to John Reed of the FCC's Office of Engineering and Technology. These documents are relevant to the above-referenced docketed proceeding, which seeks to establish rules governing the RF lighting devices. As required by Section 1.1206 of the Commission's rules, Sirius is providing two copies of this written *ex parte* presentation to the Commission for inclusion in the public record.

Should you have any questions, please contact the undersigned.

Sincerely,

Jennifer D. Hindin

Jennifer D. Hindin

cc: John Reed, OET
Robert Briskman

No. of Copies rec'd 0+4

SIRIUS
Satellite Radio

Sirius Satellite Radio
1221 Avenue of the Americas
New York, NY 10020
tel 212 584 5100
fax 212 584 5200
www.siriusradio.com

RECEIVED

JUL 31 2001

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

July 26, 2001

Federal Communications Commission
International Bureau
445 12th Street, SW
Washington, DC 20554

ATTN: John A. Reed
OET

Dear John,

As you requested, enclosed are the following documents:

1.) The NEC specification sheet for the radio-frequency front end amplifier transistors used in our receivers. Note on page two the typical Noise Figure (NF) at 2GHz is 0.23dB.

2.) The FCC Submission in 1977 by Sirius giving the total receiver system noise temperature and its major components.

3.) The IAF paper describing the Sirius SDARS. Please note Figure 6.

Please call me at (212) 584-5210 if you wish further data.

Best regards,

Rob Briskman

Robert D. Briskman
Technical Executive

Attch: Three a/s

cc: Phil Barsky
Carl Frank

bcc: Patrick Donnelly

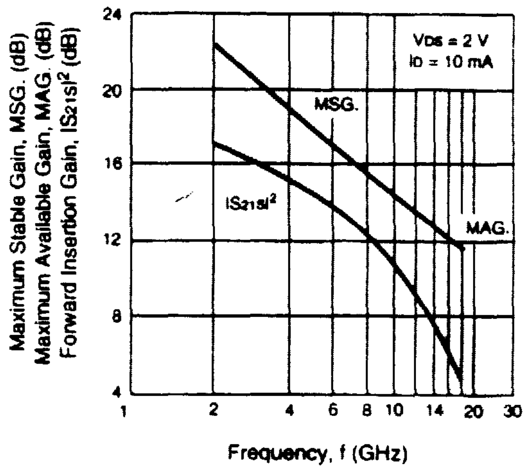
NEC

C BAND SUPER LOW NOISE HJ FET | NE334S01

FEATURES

- **VERY LOW NOISE FIGURE:** 0.25 dB TYP at 4 GHz
- **HIGH ASSOCIATED GAIN:** 16.0 dB TYP at 4 GHz
- **GATE WIDTH:** 280 μm
- **TAPE & REEL PACKAGING OPTION AVAILABLE**
- **LOW COST PLASTIC PACKAGE**

MAXIMUM AVAILABLE GAIN, FORWARD INSERTION GAIN vs. FREQUENCY



DESCRIPTION

The NE334S01 is a Hetero-Junction FET that uses the junction between Si-doped AlGaAs and undoped InGaAs to create very high mobility electrons. Its excellent low noise and high associated gain make it suitable for TVRO and other commercial systems.

NEC's stringent quality assurance and test procedures assure the highest reliability and performance.

RECOMMENDED OPERATING CONDITION (T_A = 25°C)

SYMBOLS	CHARACTERISTIC	UNITS	MIN	TYP	MAX
V_{DS}	Drain to Source Voltage	V		2	2.5
I_D	Drain Current	mA		15	20
P_{IN}	Input Power	dBm			0

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE334S01 S01		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
NF[1]	Noise Figure, V_{DS} = 2.0 V, I_D = 15 mA, f = 4 GHz	dB		0.25	0.35
G_A[1]	Associated Gain, V_{DS} = 2.0 V, I_D = 15 mA, f = 4 GHz	dB	15.0	16.0	
I_{DSS}	Saturated Drain Current, V_{DS} = 2.0 V, V_{GS} = 0 V	mA	20	80	150
g_m	Transconductance, V_{DS} = 2.0 V, I_D = 14 mA	mS	70	85	
$V_{GS(off)}$	Gate to Source Cutoff Voltage, V_{DS} = 2.0 V, I_D = 100 μA,	V	-0.2	-0.9	-2.5
I_{GSO}	Gate to Source Leak Current, V_{GS} = -3.0 V	μA		0.5	10

Note:
1. Typical values of noise figures and associated gain are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening tuned for the "generic" type but not each specimen.

ABSOLUTE MAXIMUM RATINGS[1] ($T_A = 25°C$)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	4.0
V_{GS}	Gate to Source Voltage	V	-3.0
I_{DS}	Drain Current	mA	I_{DSS}
T_{CH}	Channel Temperature	°C	125
T_{STG}	Storage Temperature	°C	-65 to +125
P_T	Total Power Dissipation	mW	300

Note:
1. Operation in excess of any one of these conditions may result in permanent damage.

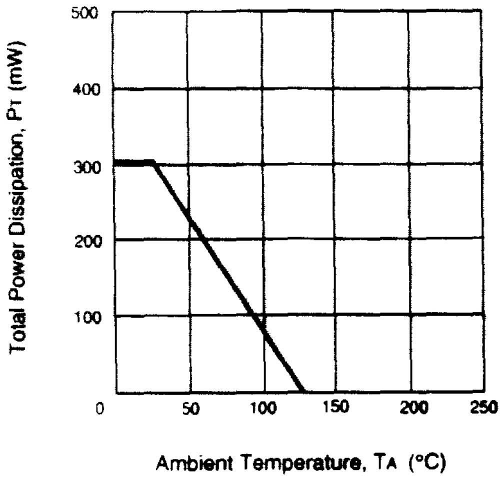
TYPICAL NOISE PARAMETERS ($T_A = 25°C$)

$V_{DS} = 2$ V, $I_{DS} = 15$ mA

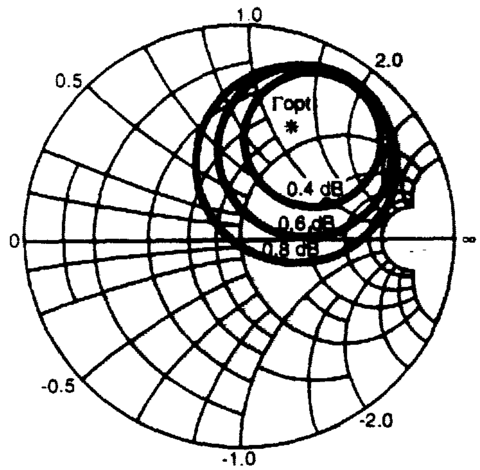
FREQ. (GHz)	NF_{MIN} (dB)	G_A (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50
2	0.23	17.0	0.77	15	0.19
4	0.25	16.0	0.58	43	0.18
6	0.28	14.7	0.43	82	0.13
8	0.31	13.6	0.32	127	0.08
10	0.38	12.5	0.27	175	0.07
12	0.48	11.5	0.27	-139	0.10
14	0.60	10.5	0.34	-100	0.17
16	0.73	9.6	0.48	-70	0.29
18	0.88	8.8	0.69	-56	0.46

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

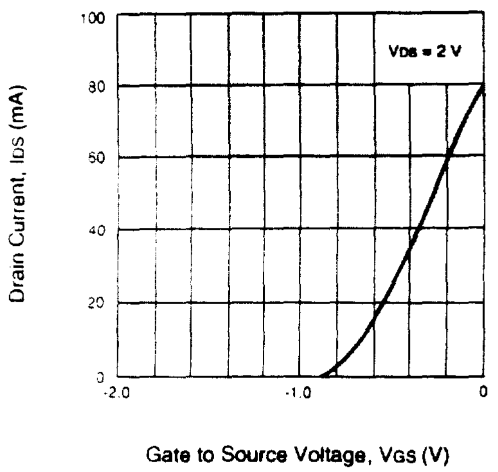
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



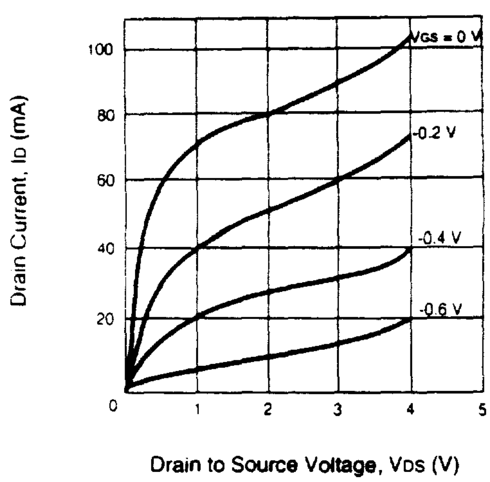
TYPICAL CONSTANT NOISE FIGURE CIRCLE ($V_{DS} = 2$ V, $I_{DS} = 15$ mA, f = 4 GHz)



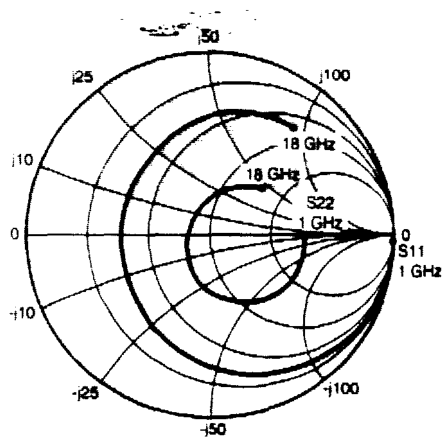
DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



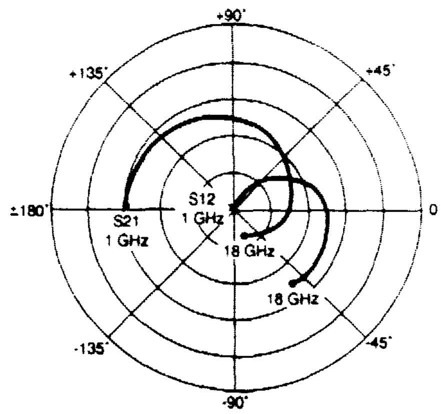
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



TYPICAL COMMON SOURCE SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
V_{DS} = 2 V, I_D = 10 mA



V_{DS} = 2 V, I_D = 10 mA

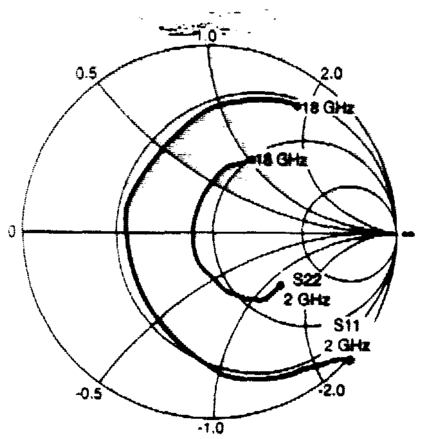
FREQUENCY	S11		S21		S12		S22		K	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.1	1.002	-2.0	5.985	177.7	0.002	96.6	0.538	-1.3	-0.17	34.5
0.5	0.996	-9.7	5.938	170.3	0.013	84.0	0.535	-7.5	0.06	26.7
1.0	0.981	-19.2	5.855	160.9	0.025	77.2	0.529	-15.1	0.14	23.7
1.5	0.960	-28.6	5.765	151.7	0.036	71.1	0.518	-22.4	0.21	22.0
2.0	0.933	-38.0	5.671	142.7	0.048	65.5	0.504	-29.9	0.26	20.8
2.5	0.903	-47.4	5.554	133.9	0.058	59.6	0.488	-37.0	0.32	19.8
3.0	0.869	-57.0	5.429	125.1	0.068	53.6	0.467	-44.3	0.37	19.0
3.5	0.829	-66.6	5.279	116.5	0.078	48.3	0.445	-51.5	0.43	18.3
4.0	0.788	-76.5	5.126	108.0	0.086	42.5	0.420	-58.3	0.49	17.7
4.5	0.746	-86.5	4.954	99.4	0.094	37.3	0.394	-65.9	0.54	17.2
5.0	0.702	-96.7	4.773	91.2	0.100	32.3	0.366	-73.2	0.60	16.8
5.5	0.662	-107.1	4.593	83.2	0.106	27.5	0.339	-81.0	0.65	16.4
6.0	0.625	-117.7	4.421	75.5	0.111	22.5	0.309	-88.6	0.70	16.0
6.5	0.594	-128.4	4.232	67.9	0.115	17.5	0.282	-96.4	0.75	15.7
7.0	0.566	-139.1	4.059	60.5	0.119	13.2	0.257	-104.5	0.79	15.3
7.5	0.545	-149.9	3.886	53.2	0.121	9.2	0.234	-112.8	0.84	15.1
8.0	0.528	-160.6	3.720	46.2	0.123	4.7	0.210	-121.7	0.88	14.8
8.5	0.514	-170.7	3.567	39.3	0.126	1.2	0.190	-129.4	0.92	14.5
9.0	0.511	179.1	3.426	32.5	0.128	-2.7	0.172	-139.7	0.95	14.3
9.5	0.510	168.8	3.292	25.8	0.129	-6.7	0.154	-150.9	0.98	14.1
10.0	0.514	158.8	3.151	19.0	0.131	-10.8	0.142	-164.7	1.01	13.2
10.5	0.521	148.9	3.021	12.5	0.132	-14.2	0.132	177.8	1.04	12.4
11.0	0.532	139.2	2.894	6.3	0.131	-17.9	0.122	158.9	1.08	11.7
11.5	0.543	131.0	2.764	0.2	0.132	-21.8	0.125	143.5	1.11	11.2
12.0	0.562	123.0	2.654	-6.0	0.132	-25.0	0.138	128.5	1.12	10.9
12.5	0.580	115.5	2.544	-12.2	0.131	-28.8	0.153	115.5	1.14	10.6
13.0	0.598	108.5	2.437	-18.1	0.131	-32.0	0.172	104.0	1.15	10.3
13.5	0.618	102.0	2.338	-24.2	0.130	-35.5	0.189	95.6	1.16	10.1
14.0	0.627	95.8	2.251	-30.3	0.129	-39.0	0.203	87.7	1.18	9.8
14.5	0.642	90.1	2.161	-36.3	0.129	-42.3	0.223	82.4	1.18	9.6
15.0	0.657	84.4	2.074	-42.3	0.130	-46.2	0.243	75.6	1.19	9.4
15.5	0.671	78.8	1.987	-48.6	0.127	-50.0	0.262	69.7	1.21	9.2
16.0	0.687	73.6	1.902	-54.5	0.126	-54.0	0.284	63.5	1.21	9.0
16.5	0.704	68.2	1.821	-60.3	0.126	-57.5	0.306	57.0	1.21	8.8
17.0	0.718	63.2	1.736	-66.0	0.123	-61.2	0.328	52.2	1.23	8.6
17.5	0.731	58.7	1.649	-71.7	0.121	-64.3	0.347	47.6	1.25	8.4
18.0	0.749	53.9	1.580	-77.1	0.120	-68.0	0.371	42.6	1.23	8.3

Note:
1. Gain Calculations:

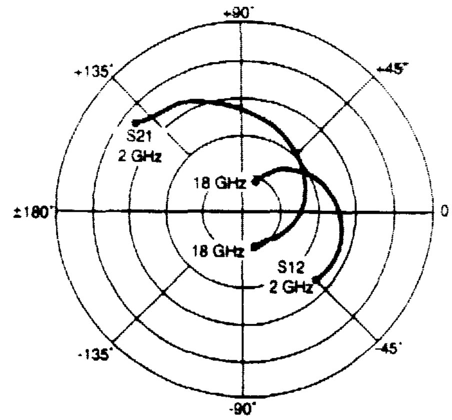
$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL COMMON SOURCE SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
V_{DS} = 2 V, I_D = 15 mA



V_{DS} = 2 V, I_D = 15 mA

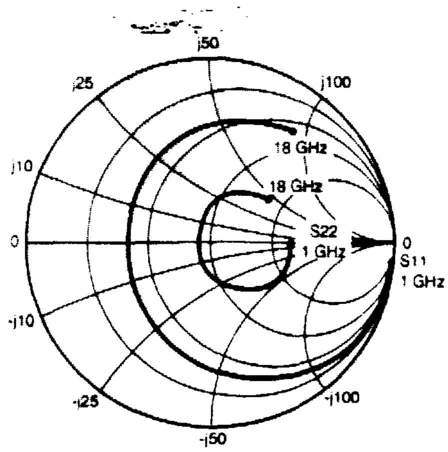
FREQUENCY (GHz)	S_{11} MAG	S_{11} ANG	S_{21} MAG	S_{21} ANG	S_{12} MAG	S_{12} ANG	S_{22} MAG	S_{22} ANG	K	MAG[1] (dB)
2.0	.998	-41.7	7.162	140.1	.042	68.4	.415	-27.5	.10	41.82
2.5	.927	-47.5	6.856	133.6	.050	65.9	.479	-35.8	.23	26.36
3.0	.860	-61.3	6.603	122.0	.057	57.5	.423	-43.0	.39	23.09
3.5	.829	-69.9	6.305	114.4	.064	54.1	.429	-47.9	.42	21.91
4.0	.802	-79.2	6.033	106.8	.071	49.6	.426	-51.7	.45	20.95
4.5	.716	-87.5	5.687	98.5	.075	45.8	.406	-56.2	.60	19.00
5.0	.659	-93.9	5.415	91.6	.081	41.1	.394	-59.7	.69	17.88
5.5	.601	-99.7	5.184	84.7	.085	38.9	.374	-63.3	.78	16.89
6.0	.592	-108.5	5.050	77.6	.091	35.2	.340	-68.1	.79	16.47
6.5	.550	-118.5	4.912	70.5	.096	30.8	.311	-73.0	.84	15.83
7.0	.514	-130.2	4.774	63.0	.102	27.3	.279	-79.1	.87	15.26
7.5	.488	-144.5	4.600	55.4	.107	22.0	.232	-87.5	.91	14.68
8.0	.464	-158.9	4.401	47.9	.109	18.6	.189	-97.7	.96	14.08
8.5	.463	-171.7	4.187	41.0	.113	14.9	.155	-109.3	.98	13.59
9.0	.468	176.6	3.997	34.1	.114	11.5	.134	-126.9	1.00	15.01
9.5	.472	166.4	3.812	27.7	.118	7.7	.121	-142.8	1.02	14.21
10.0	.472	156.2	3.628	21.5	.119	4.7	.111	-156.2	1.06	13.37
10.5	.476	147.0	3.477	15.6	.122	1.0	.103	-170.1	1.08	12.86
11.0	.476	137.8	3.351	9.6	.124	-2.5	.098	174.4	1.10	12.36
11.5	.488	127.7	3.251	3.5	.125	-5.8	.093	157.9	1.12	12.06
12.0	.518	118.1	3.150	-2.9	.128	-9.2	.105	137.6	1.10	11.98
12.5	.552	109.6	3.036	-9.7	.130	-12.9	.131	121.0	1.08	11.92
13.0	.593	101.9	2.875	-16.4	.131	-16.7	.177	107.0	1.07	11.79
13.5	.635	95.2	2.714	-22.7	.129	-21.2	.223	97.8	1.06	11.70
14.0	.661	90.1	2.546	-28.1	.126	-22.5	.259	91.0	1.08	11.29
14.5	.688	86.1	2.418	-32.6	.124	-24.9	.284	87.0	1.08	11.17
15.0	.707	82.2	2.327	-37.0	.127	-27.4	.316	86.0	1.05	11.30
15.5	.719	79.7	2.240	-41.8	.126	-28.8	.332	83.3	1.04	11.20
16.0	.730	76.1	2.168	-46.8	.129	-31.6	.352	81.7	1.01	11.55
16.5	.752	71.3	2.100	-52.7	.131	-33.2	.380	77.4	.98	10.74
17.0	.771	65.5	2.021	-58.4	.130	-38.5	.398	72.4	.96	10.78
17.5	.803	60.4	1.930	-65.1	.134	-42.2	.422	66.5	.89	11.05
18.0	.817	55.7	1.814	-70.5	.128	-44.3	.445	62.9	.91	10.92

Note:
1. Gain Calculations:

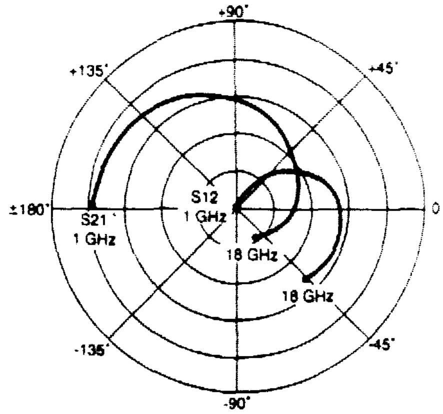
$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right).$$ When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL COMMON SOURCE SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
V_{DS} = 2 V, I_D = 20 mA



V_{DS} = 2 V, I_D = 20 mA

FREQUENCY (GHz)	S_{11} MAG	S_{11} ANG	S_{21} MAG	S_{21} ANG	S_{12} MAG	S_{12} ANG	S_{22} MAG	S_{22} ANG	K	MAG[1] (dB)
0.1	1.002	-2.2	7.768	177.7	0.003	83.5	0.439	-1.4	-0.01	33.9
0.5	0.994	-10.7	7.685	169.3	0.011	85.2	0.436	-7.7	0.08	28.4
1.0	0.974	-21.3	7.530	159.0	0.022	77.5	0.430	-15.5	0.18	25.3
1.5	0.946	-31.7	7.350	149.1	0.033	71.7	0.419	-23.1	0.26	23.5
2.0	0.911	-41.9	7.155	139.5	0.042	66.3	0.405	-30.5	0.33	22.3
2.5	0.870	-52.0	6.927	130.1	0.051	61.3	0.388	-37.8	0.40	21.3
3.0	0.826	-62.2	6.682	121.0	0.060	55.8	0.367	-45.0	0.47	20.5
3.5	0.780	-72.4	6.418	112.1	0.068	50.5	0.346	-52.1	0.53	19.7
4.0	0.733	-82.6	6.152	103.5	0.076	45.6	0.322	-58.7	0.60	19.1
4.5	0.685	-93.1	5.871	95.0	0.083	40.9	0.298	-66.3	0.65	18.5
5.0	0.640	-103.6	5.592	86.9	0.088	36.3	0.272	-73.5	0.71	18.0
5.5	0.599	-114.3	5.326	79.1	0.094	31.9	0.248	-81.3	0.76	17.6
6.0	0.565	-125.1	5.077	71.6	0.099	27.7	0.222	-89.0	0.81	17.1
6.5	0.536	-136.0	4.822	64.3	0.103	23.8	0.198	-97.3	0.85	16.7
7.0	0.512	-146.9	4.595	57.2	0.107	19.5	0.176	-106.2	0.90	16.3
7.5	0.496	-157.8	4.375	50.2	0.111	16.0	0.156	-115.6	0.93	16.0
8.0	0.483	-168.6	4.166	43.5	0.113	11.8	0.138	-126.3	0.97	15.7
8.5	0.473	-178.5	3.979	37.0	0.117	8.6	0.120	-135.8	1.00	15.3
9.0	0.475	171.5	3.807	30.4	0.120	5.0	0.107	-149.5	1.02	14.2
9.5	0.478	161.6	3.644	24.0	0.123	1.2	0.096	-165.3	1.04	13.5
10.0	0.487	152.0	3.479	17.6	0.125	-2.9	0.092	175.2	1.06	13.0
10.5	0.498	142.5	3.327	11.4	0.128	-6.2	0.097	152.5	1.07	12.5
11.0	0.514	133.3	3.181	5.4	0.128	-9.7	0.103	130.1	1.10	12.0
11.5	0.527	125.6	3.036	-0.4	0.130	-13.7	0.116	116.5	1.11	11.6
12.0	0.548	118.1	2.911	-6.4	0.131	-17.1	0.137	104.9	1.12	11.4
12.5	0.569	111.1	2.789	-12.3	0.132	-21.0	0.160	95.2	1.13	11.1
13.0	0.589	104.4	2.670	-18.0	0.132	-24.2	0.184	86.9	1.13	10.8
13.5	0.610	98.4	2.562	-23.8	0.132	-28.0	0.203	80.3	1.14	10.6
14.0	0.620	92.4	2.466	-29.7	0.134	-31.7	0.218	73.7	1.15	10.3
14.5	0.636	86.9	2.368	-35.5	0.134	-35.6	0.237	69.5	1.15	10.2
15.0	0.652	81.5	2.272	-41.4	0.134	-39.6	0.259	64.1	1.15	10.0
15.5	0.668	76.1	2.178	-47.5	0.134	-43.7	0.277	58.7	1.15	9.8
16.0	0.684	71.2	2.082	-53.2	0.133	-48.0	0.300	53.8	1.16	9.6
16.5	0.702	66.1	1.994	-58.8	0.132	-51.5	0.324	48.2	1.15	9.4
17.0	0.716	61.1	1.904	-64.3	0.130	-55.5	0.344	44.0	1.16	9.2
17.5	0.731	56.8	1.810	-69.8	0.128	-59.1	0.362	39.7	1.17	9.0
18.0	0.750	52.0	1.737	-75.0	0.127	-62.6	0.385	35.1	1.16	8.9

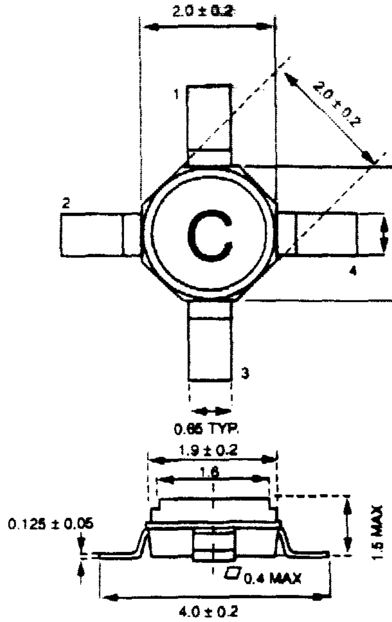
Note:
1. Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE S01



1. Source
2. Drain
3. Source
4. Gate

ORDERING INFORMATION

PART NUMBER	AVAILABILITY	PACKAGE
NE334S01	Bulk	S01
NE334S01-T1	Tape & reel 1K/reel	S01
NE334S01-T1B	Tape & reel 4K/reel	S01

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of: **Satellite CD Radio, Inc.** Application to Launch and Operate a Digital Audio Radio Satellite Service in the 2320-2332.5 MHz Frequency Band	49/50-DSS-P/L-90 58/59-DSS-AMEND-90 44/45-DSS-AMEND-92

Submission and Amendment to Application of Satellite CD Radio, Inc.

Robert D. Briskman
Satellite CD Radio, Inc.
1001 22nd Street, 6th Floor
Washington, D.C. 20037
(202) 296-6192

Dated: May 16, 1997

The receivers for mobile applications have a G/T of -19 dBK based on a minimum antenna gain of 3-dBi. Table 2 is the receiver's system noise budget. The normal version of the receiver has two demodulator channels, one for each satellite for spatial diversity with one channel containing a 4 second buffer used to achieve time diversity. Upper-end versions contain additional demodulator channels (i.e., rake design). The receivers for other applications are similar, except for a version in fixed applications which has no diversity demodulator channels and has a remote unit which re-transmits the signal received by the antenna unit to a remotely located player unit in the home using an ISM frequency band.

Table 2: SDARS Receiver Noise Temperature

Antenna-Receiver Losses		7° K
Receive Total Noise		65° K
Antenna Earth Pickup		86° K
	Total	158° K

Some changes in the receiver design may occur as a result of interoperability discussions just commenced with AMRC/Worldspace and future standardization discussions previously noted.

The up-link earth station also provides the CD Radio programming center and the on-orbit TT&C facilities. The first one will be built in New York City, New York and a second, redundant one will be subsequently built in the west, possibly in Denver, CO. The radio facilities of the up-link station comprise two 5 meter diameter antennas and 2500 watt 7000 MHz transmitters. Full electronic and electrical redundancy are planned.

Regarding noise and interference sources, the 2320-2332.5 MHz radio frequency band has no other significant terrestrial users in the United States. Canada uses the band for terrestrial radio relay and some aeronautical telemetry and Mexico for terrestrial radio relay as well documented elsewhere by the FCC. Interference situations with adjacent Administrations will be coordinated including border situations with mobile receivers and with terrestrial repeaters.

Interference between SDARS systems will be coordinated with AMRC/Worldspace. Adjacent band interference will be coordinated with applicable WCS operators recognizing that the FCC has set an out-of-band interference requirement on these operators. Noise sources such as microwave ovens and ISM out-of-band radiation have been analyzed and are tolerable. Some of these sources, including self-interference, are mitigated by properties of the code division multiplex (i.e., spread spectrum transmission) where 17 dB of spreading ratio protection is provided.

The overall transmission link performance analysis is contained in Table 3.

Table 3: Transmission Link Performance

Satellite EIRP[32]	+59.7 dBw
Single Channel EIRP[33]	-15.6 dB
Path Loss[34]	-191.6 dB
Mobile Receiver Antenna Gain[35]	+3.0 dBi
Received Power	-144.5 dBw
Received Noise Power[36]	-155.5 dBw
Single Satellite S/N	11.0 dB
Required S/N[37]	5.0 dB
Single Satellite Power Margin[38]	6.0 dB
Diversity Gain[39]	12.0 dB
Effective Multipath Margin	18.0 dB

[32] Coverage edge -2 dB contour of Figure 6.

[33] 36 128 kb/s channels.

[34] Geosynchronous orbit for 2332 MHz.

[35] Worst case orientation, including ohmic and polarization losses.

[36] B_N = 128 kHz, T_S = 158°K (Table 2), up-link noise contribution is negligible (> 30 dB S/N).

[37] CD quality achieved by PAC decoder with $\geq 10^{-5}$ BER.

[38] Dual satellite reception with maximal ratio combiner S/N = 8.5 dB.

[39] Satellite spatial and time diversity provide at least 12 dB multipath mitigation as well as mitigation against blockage and foliage attenuation.

IAF-00-M.5.03

S-DARS DOMESTIC IMPLEMENTATION

Robert D. Briskman
Executive Vice President, Engineering
Sirius Satellite Radio

51st International Astronautical Congress
2-6 Oct 2000/Rio de Janeiro, Brazil

S-DARS DOMESTIC IMPLEMENTATION

Robert D. Briskman
Executive Vice President, Engineering
Sirius Satellite Radio
New York, NY USA

ABSTRACT

The first domestic S-DARS (Satellite-Digital Audio Radio Service) system is being implemented in the United States of America and is currently scheduled to start operation by the end of year 2000. The system is designed to provide radio service to mobile users, especially to the over 200 million vehicles in the 48 contiguous United States. The service provides up to 100 audio channels, typically 50 music channels without advertising and 50 voice channels, to customers on a subscription basis using the 2.3 GHz frequency band. The satellite constellation comprises three satellites in inclined, elliptical geosynchronous orbits whose planes are separated by 120° and is supplemented by terrestrial transmitters that re-transmit the satellite signal in urban cores. The system implementation and the use of diversity to achieve high subscriber service availability are described. The system design employs space, time and frequency diversity as well as that achieved through use of the terrestrial transmitters and receiver equalization of multipath.

INTRODUCTION

The S-DARS system described herein will provide up to 50 music channels and 50 voice channels to subscribers throughout the 48 contiguous United States (CONUS) with high digital quality and in all outdoor locations (i.e., seamlessness). The service is intended primarily for mobile users, but fixed and transportable users can also be served. To accomplish the high mobile service quality, the system design uses spatial, time and frequency diversity as well as providing high elevation angles from the satellites to users and receiver multipath equalization. Additionally, the system uses terrestrial repeaters of the satellite signal to eliminate outages when user receivers are operating in the urban cores of major cities and in obstructed areas such as long tunnels.

Orbit

Type	Geosynchronous
Inclination	63.4°
Perigee Altitude	24469 km
Apogee Altitude	47102 km
Eccentricity	0.2684
Period	24 hours
Relative Phasing	8 hours
Argument of Perigee	270°

Table 1

SYSTEM CONFIGURATION

The system configuration is shown in Figure ~~1, and~~ the three satellite orbital constellation is shown in Figure 2. The orbital parameter values of the geosynchronous satellites are shown in Table 1. The satellites follow each other around the ground track shown in Figure 2 separated in time by 8 hours. The result of this orbital configuration is that very high elevation angles (e.g., 60°) are available to users in the northern third of CONUS. An illustration of this coverage for users in the Seattle, Washington region is shown in Figure 3. The illustration also shows that the selected orbit allows each satellite to provide coverage of CONUS for approximately sixteen hours. Two of the three satellites are active at any one time, both providing an identical transmission to CONUS subscribers.

Sirius SDARS Delivery System

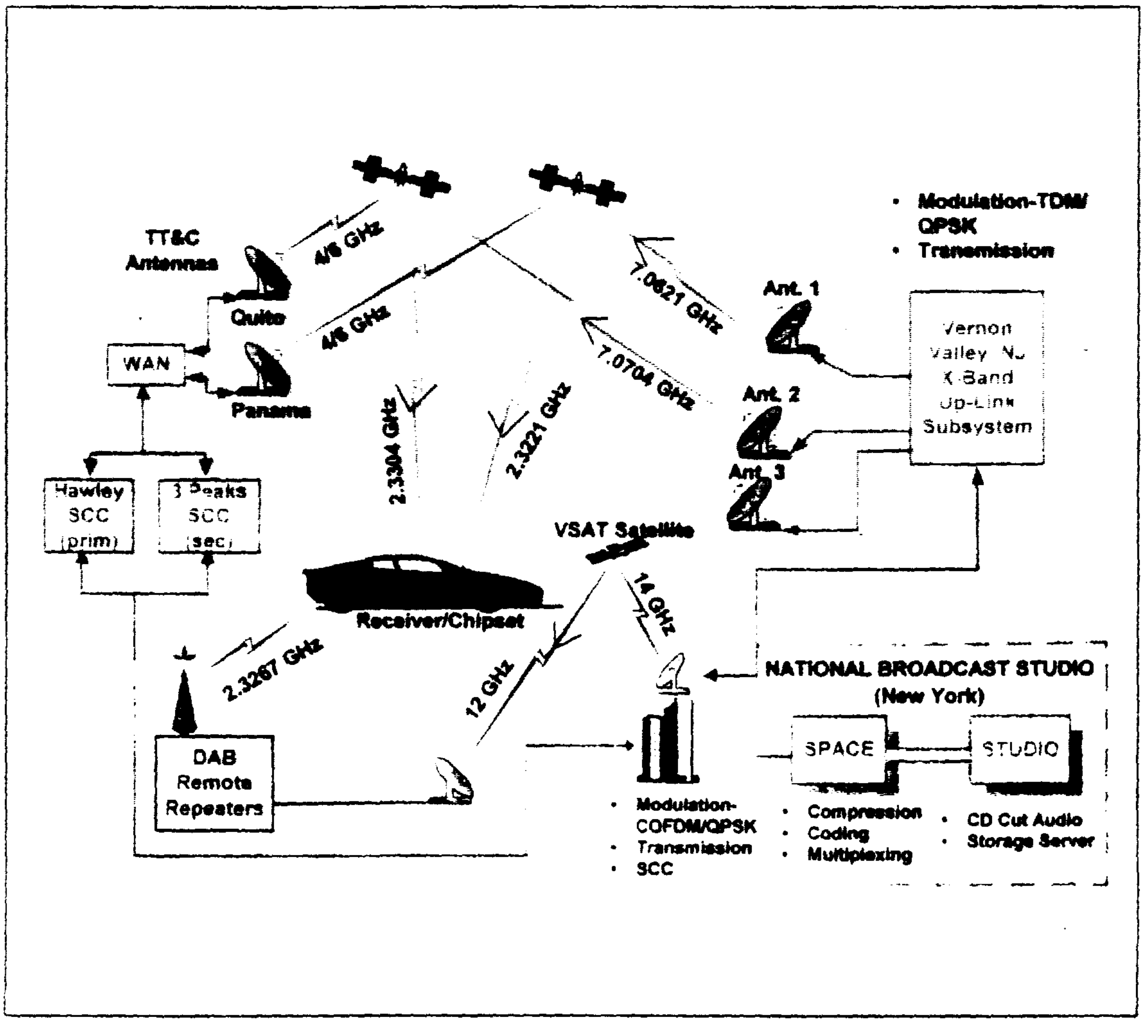


Figure 1

Sirius Satellite Ground Track

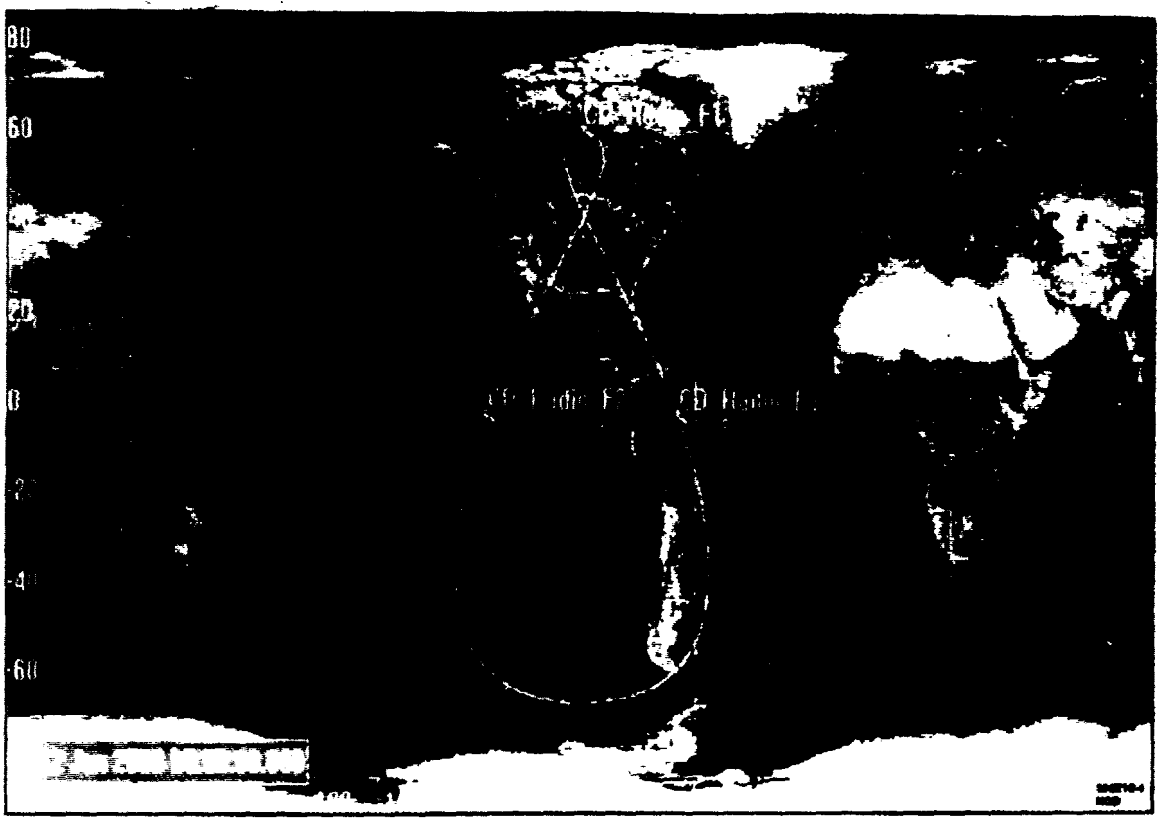


Figure 2

Coverage Comparison of Current vs. Original Orbits (Seattle)

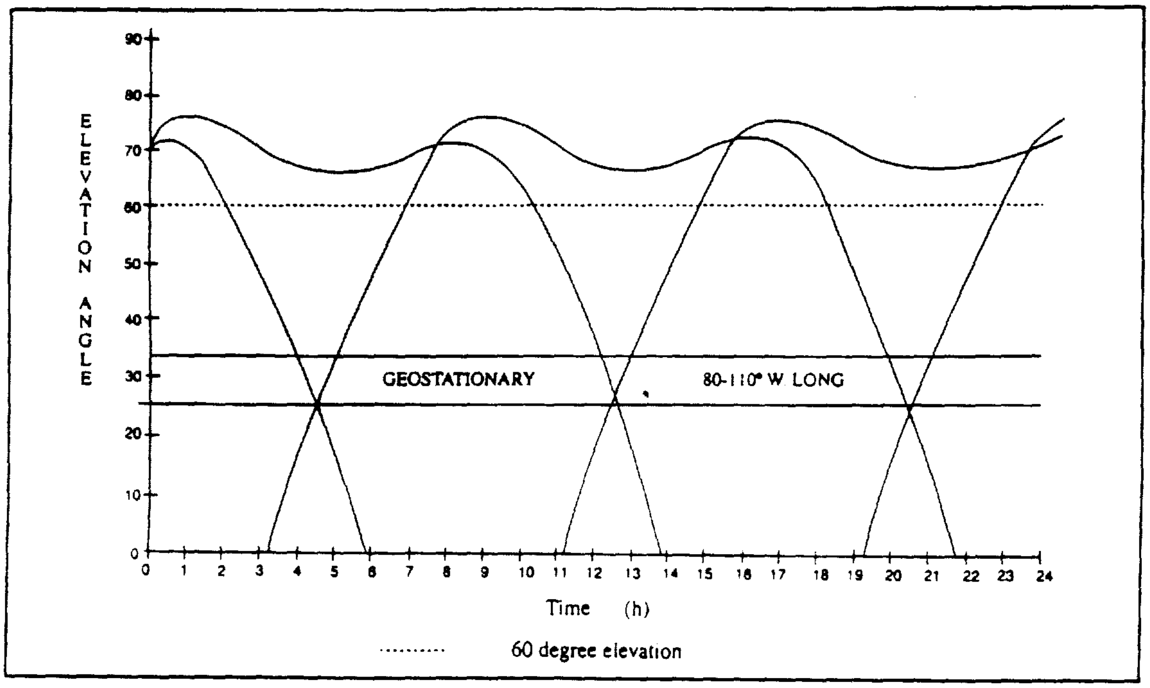


Figure 3

SYSTEM DIVERSITY

Diversity is essential for providing a high quality mobile service such as S-DARS. Frequency diversity is achieved by the use of two transmission frequencies from the active satellites spaced 8 MHz apart as shown in Figure 1. High elevation angles are critical as shown in Figure 4. Spatial diversity is essential for user elevation angles between 25° – 50°. High elevation angle signal reception and spatial diversity are also essential in reducing the otherwise large transmission margin required to overcome foliage attenuation as shown in Figure 5. However, blockage outages of both satellites can still occur from obstructions such as large overpasses. Such outages can be eliminated in most cases by the use of time diversity. This is accomplished by introducing a 4 second delay between the transmissions from the two active satellites and storing the earlier arriving transmission in each receiver for playback when such dual blockage outages occur.

Path Blockage Probability in a Suburban Area

Ns = Number of Satellites

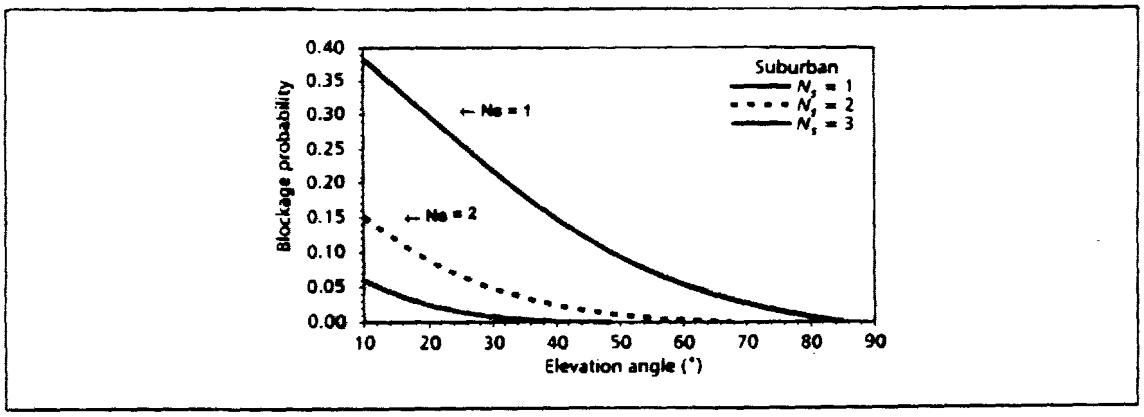


Figure 4

Foliage Attenuation

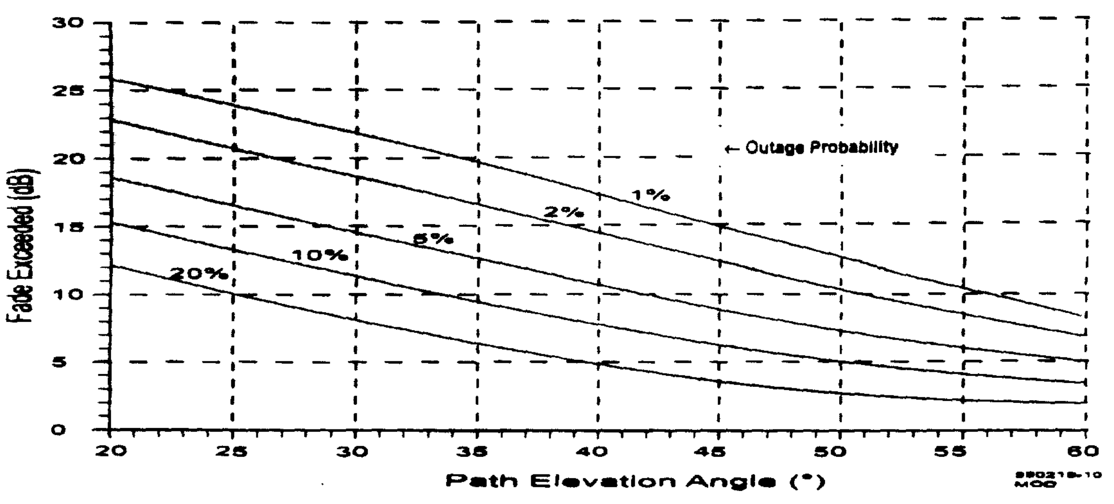


Figure 5

FACILITY DESCRIPTIONS

The parameter values of the satellites are summarized in Table 2, and the completed tracking, telemetry and command (TT&C) subsystem in Table 3 uses earth stations in Ecuador and Panama. Four satellites have been built, one is intended as an on-ground spare. Launches are expected to commence this summer. The construction of the National Broadcasting Studio, the Satellite Control Centers and the up-link earth station in Vernon Valley, NJ (see Table 4) has been completed.

The 105 terrestrial repeaters in 46 cities have been sited, and installation is scheduled for completion this fall. Figure 6 is a block diagram of the user radio which has been engineered by Lucent Technologies who is manufacturing the receiver chip sets. Testing of receivers is scheduled to start this fall. The receivers incorporate a six tap equalizer for multipath as well as the previously mentioned 4 second storage for time diversity.

User Radio Block Diagram

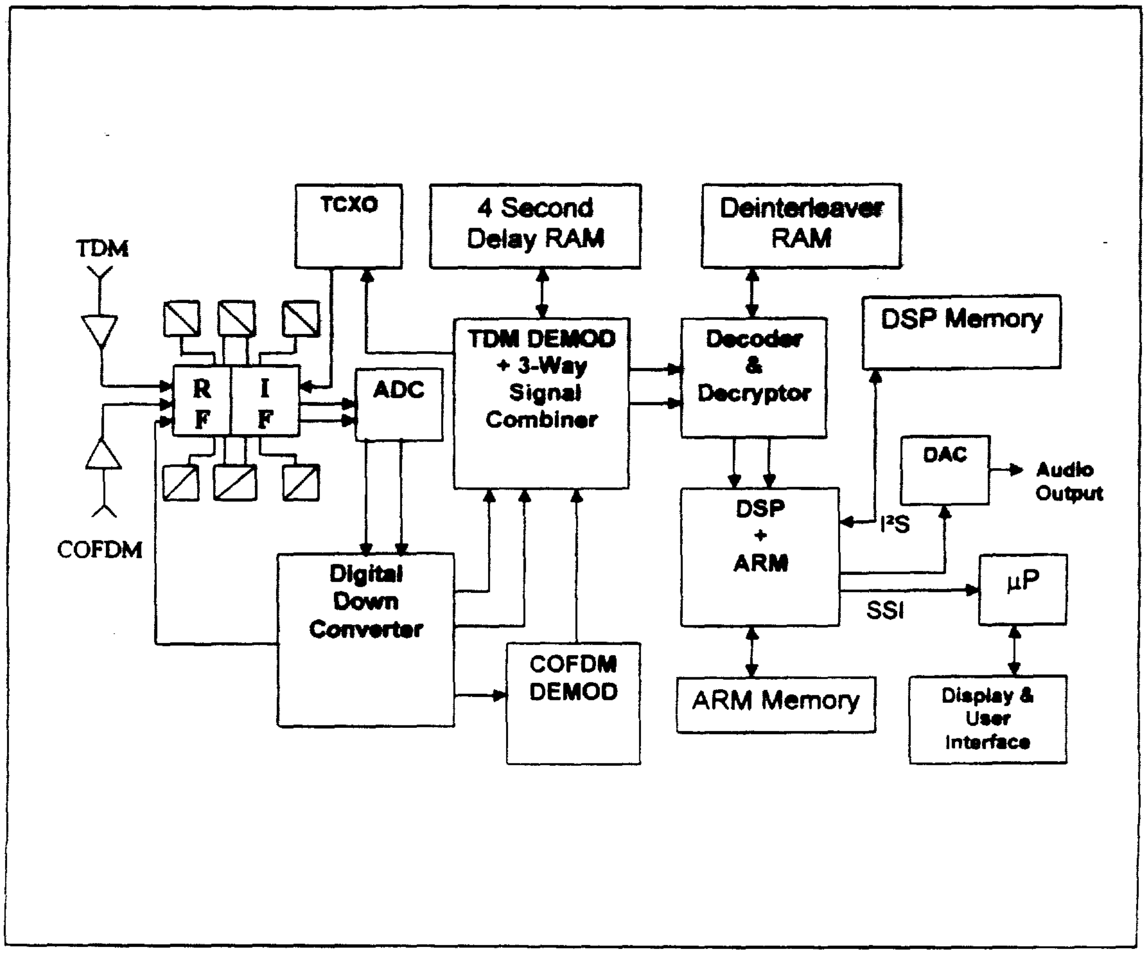


Figure 6

SUMMARY

The first United States S-DARS is expected to be operational this winter. The system will provide a very high service quality and availability to millions of subscribers through the use of innovative technology and of several simultaneous modes of transmission diversity.

SATELLITES

Manufacturer/Type	Space Systems Loral, Model FS1300, Proton or Sea Launch
Design Life	15 years
Weight at Launch	3900 kg
Dimensions	24.8 meters long, 5.6 meters wide and 5.2 meters high
Payload	One transponder consisting of 16 active and 8 spare DTWTAs
Max Beam EIRP	67 dBW
Attitude Control	Momentum bias with 3 active and one redundant reaction wheel for Orbit Normal and Yaw Steering capabilities
Power Generation	2 solar arrays of 5 panels each. Total 9.3 kW solar power at 15 years

Table 2

TELEMETRY & COMMAND

Telemetry F1 Frequency TLM1	4196.5 MHz
Telemetry F2 Frequency TLM2	4197.0 MHz
Telemetry EIRP Max	0 dBW (minimum)
Telemetry Signal Polarization	RHCP
Command F1 Frequency CMD1	6422.5 MHz
Command F2 Frequency CMD2	6424.5 MHz
Command Sensitivity	-90 dBW/m2
Command Signal Polarization	LHCP

Table 3

UP-LINK EARTH STATION

Size	4.57 meter diameter
Transmit Gain	48.6 dBi
Receive Gain	31.0 dBi
Primary Tracking Mode	Program Track
Up-link Polarization	RHCP
Transmitter Output Power	1600.0 Watts
Up-link EIRP	74.4 dBW
Up-link Availability	> 99.9999%

Table 4